Making single system backup easy

Using the HP StorageWorks RDX Removable Disk Backup System

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Executive Summary

Traditionally server or workstation backup can prove too inconvenient for many micro or small businesses that lack sufficient time, budget or expertise to implement a truly usable and practical backup solution.

HP solves this problem with the HP StorageWorks RDX Removable Disk Backup System by combining the best features of tape (removable, portable, rugged media) and the best of disk (fast, random access, and rapid capacity growth) with the simplicity of universal USB connectivity.

Included with the product is HP StorageWorks RDX Continuous Data Protection Software which brings industry-leading features such as disk snapshots, continuous data protection (CDP), file revisions, deduplication, bare-metal recovery and simple media management together in an exceptionally easy to use, set-and-forget package for micro and small businesses.

This whitepaper looks at RDX technology, explains how it works, and recommends some typical usage models.

Technology Overview

It has been the case for some time now that affordable, simple and reliable data protection for small or micro-businesses and individual professionals has always sat in the "too hard" basket. Many technologies (optical, zip, LS120, and so on) have come and gone, being touted as the "ideal" backup medium but each one of these has fallen away as hard disk capacities out-pace each newcomer and the shortcomings of each format are exposed. The exception to this has always been tape, where performance and capacity has improved in step with disk over many decades. Coupled with the portability and robustness of its media, tape remains the answer for those businesses with sophisticated backup requirements for "best practice" media rotation schemes and cost effective/durable archiving to meet regulatory requirements. Tape allows them to protect their existing tape media investment and benefit from the low cost of ownership and proven reliability they have come to expect from HP.

The typical HP RDX user requires a simple two or three cartridge onsite/offsite backup rotation with end-of-year archiving, disaster recovery, and data transfer from home to office or office to client. For this usage model HP RDX offers the most cost-effective solution. However if a customer requires more than 4 or 5 cartridges for multiple cartridge rotation and high volume durable archiving, the economics of tape media versus RDX disk cartridges mean that HP DAT becomes the more economical choice.

Micro and small businesses are seeing increases in data storage and protection needs that cannot be met by their current backup processes. These companies generally have no staff dedicated to backing up data and no formal backup procedures. They may be experiencing capacity limitations backing up to CD or DVD, or may be concerned about the security of backing up to external USB drives. The RDX Removable Backup System offers these customers the higher capacity and performance of disk backup as well as the security of being able to store backup cartridges off-site.

With the HP StorageWorks RDX Backup System the best features of disk and tape combine, plus low cost of entry are coupled with the set-and-forget simplicity of HP StorageWorks RDX Continuous Data Protection Software. Once installed the software runs automatically as a background service and immediately begins backing up your system to RDX. The software continues to backup new files automatically; as they are created or revised, providing seamless total protection of your data and allowing you to revise individual files or your entire system, back to previous points in time. Typically RDX can recover your system to within the last 24 hours or less.

Positioning

The HP StorageWorks RDX Removable Disk Backup System is an easy to use, affordable and rugged removable disk backup solution for workstations and entry level servers:

Simplicity–The RDX Removable Disk Backup System connects to a USB port; backup is accomplished using backup software or by dragging and dropping files.

Value–The system is both affordable and scalable; the long lifespan of cartridges minimizes media replacement costs, and there is no need to replace the docking station when future higher capacity cartridges become available.

Security–Both portable and durable, the disk cartridges can be readily moved and stored offsite for increased data protection.

Ideally suited to backing up a standalone server or workstation, the user simply chooses a cartridge size equal to or larger than their current hard disk, inserts it in the dock, and the software takes over from there. It is even possible to back up data through simple "drag and drop" or a copy operation scheduled by the OS.

HP StorageWorks RDX Removable Disk Backup System

RDX technology

The RDX system performs traditional backups by moving data directly to a business-grade, durable and removable cartridge. The recording media, a hard disk drive, can be safely stored for long periods, backs up over 100 GB in an hour, and retrieves files in milliseconds.

Robust Media

RDX media consists of an industry-standard 2.5" disk drive that can sustain a 30MB/s data transfer rate through a USB-2 interface capable of a 480MB/s burst transfer rate. This allows a backup rate up to 108 GB per hour (host and device-driver dependant). The 2.5" SATA disk drive features include ramp loading heads, fluid dynamic bearings, and inactive state spin-down to enhance reliability. This design is typical of those used in laptop computers where reliability on the move is extremely important.

The 2.5" HDD is suspended in a ruggedized, shock-proof RDX cartridge that meets drop test requirements of 1meter (39.37 inches) onto a concrete floor without damage. Cartridge construction is a high-strength plastic formulation designed to provide protection against Electrostatic Discharge (ESD). The cartridge's industry standard SATA connector for interfacing with the dock is rated at over 5,000 load/unload cycles – assuming one cycle per day this equates as nearly seven years of use.

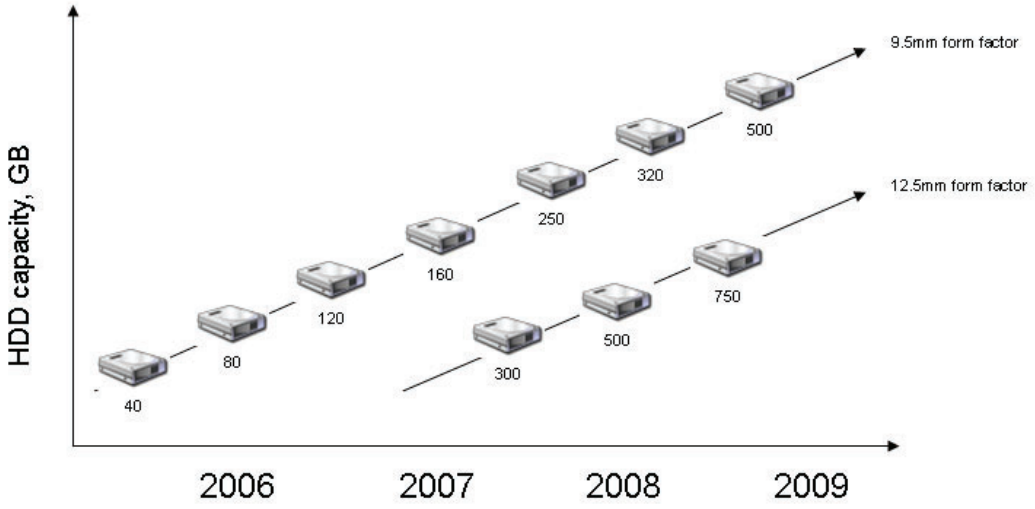
Simple Dock Installation

RDX internal and external docks are USB plug-and-play, being directly detected and installed by all recent operating systems. Being a Removable HDD (RHDD) device, many common backup applications are immediately compatible, allowing installation without software changes that might complicate existing backup processes or add further cost to the system. The dock is specified for more than 10,000 load/unload cycles – at one cycle per day this approaches a life expectancy of 14 years.

Backward and Forward Compatibility

Upgrading to the next generation does not require the complete purchase of new drives. RDX docks are backward and forward compatible with all existing and future RDX cartridges, giving a productive life span considerably longer than most technologies. As the RDX media are an industry-standard 2.5" HDD, advancement in disk capacities will be immediately compatible with your system. Tomorrow's higher capacity RDX cartridges will operate in today's RDX docks. The product leverages the hard disk drive industry's mobile 2.5" HDD roadmap with new higher capacity cartridges expected to be introduced on an annual basis.

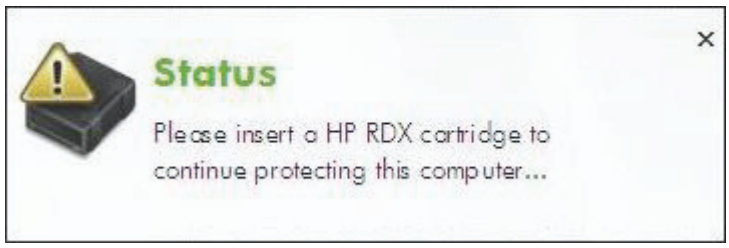
Figure 1: Past and projected growth in 2.5" hard disk capacities



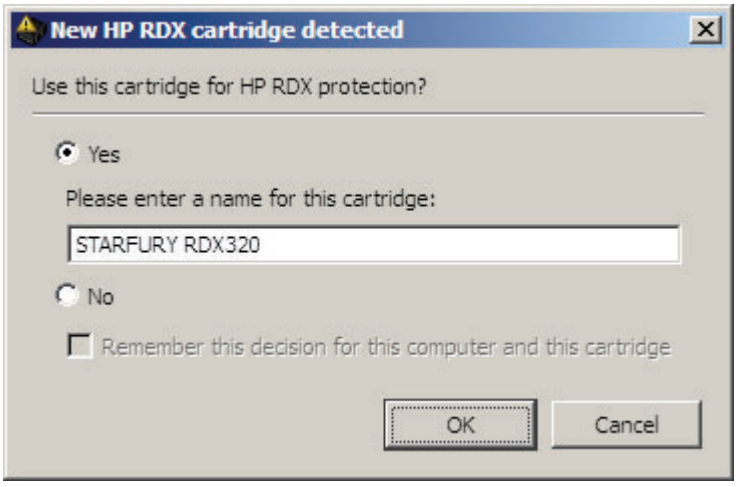
HP StorageWorks RDX Continuous Data Protection Software

The included RDX Continuous Data Protection Software is designed for ease of use and complete workstation and server backup protection. Key features of the HP RDX continuous data protection software include continuous data protection, data deduplication, bare metal restore, seamless cartridge rotation and archiving support, simple file recovery, complete backup coverage (unlimited file versions, open files, application data user settings and the complete operating system are all automatically backed up), and comprehensive backup status updates.

Upon insertion of the HP RDX Continuous Data Protection Software CD the End User License Agreement is displayed, once accepted it takes only a short time to install the software and display a confirmation screen. You are then prompted to insert a cartridge:



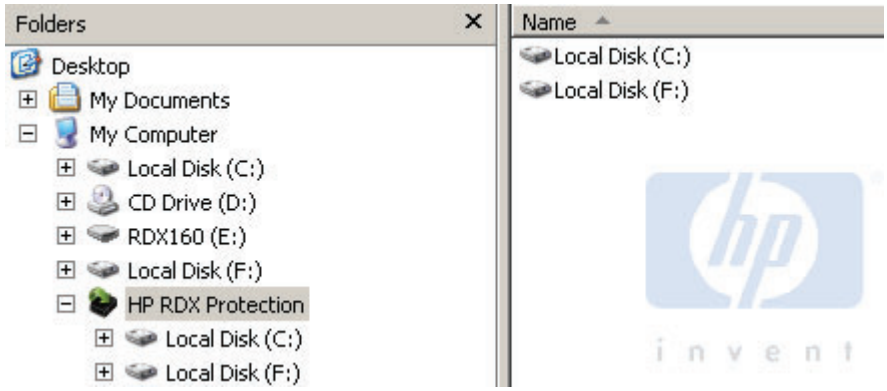
Whenever you insert a blank RDX cartridge for the first time, the 'New HP RDX cartridge detected' dialog is displayed. The cartridge name defaults to <machine name><date>; this name may be changed:



Choosing “No” allows the cartridge to be used as USB disk via Windows Explorer. (This decision and the cartridge’s serial number are recorded; upon future insertion of recognized cartridges the question is not asked). On choosing “Yes” and clicking “OK” the RDX software writes a small amount of its own management information to the cartridge. The first backup starts:

The RDX software protects all system data on all hard disks installed in the system as shown below:

Figure 2: Both local hard disks are RDX protected

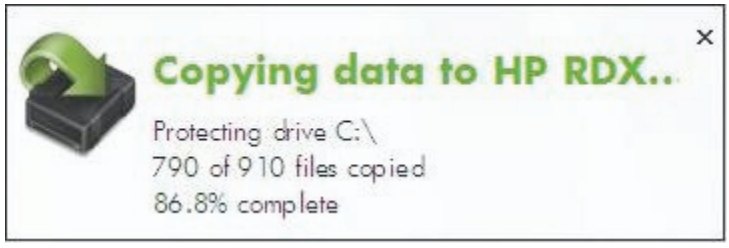


(NOTE: A cartridge of equal or larger capacity than both disks will be required).

The initial backup may take some time to complete and will create a base Recovery Point:

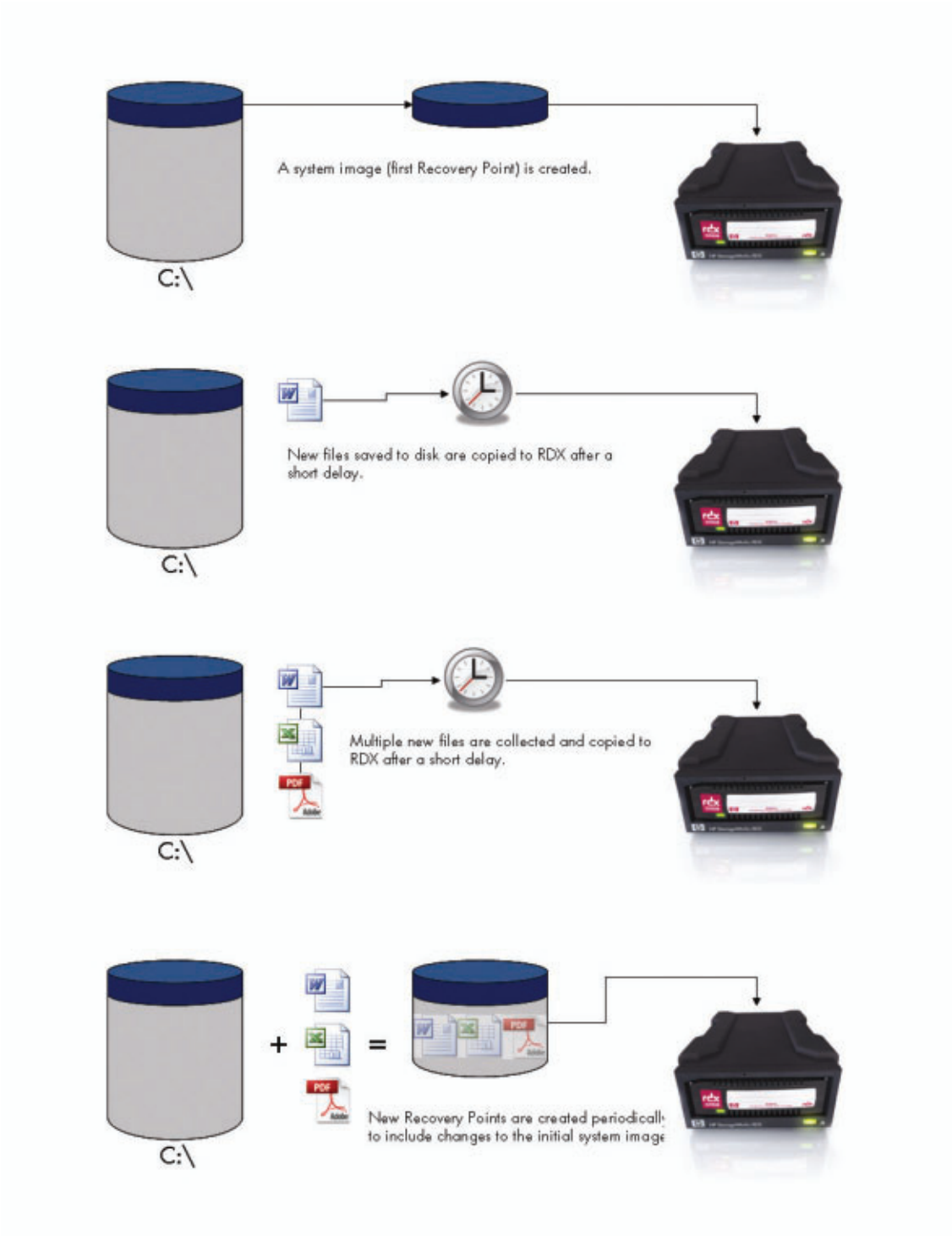
This initial recovery point is a complete snapshot of the system and the foundation of a total system recovery. Additional recovery points are created at regular intervals. It is during the creation of recovery points that open-file-backup of services like Exchange or SQL are performed. These additional points contain only the changes to the file-system's block-level data since the first recovery point was taken. Each subsequent point only contains the changes since the one previous, reducing time taken to backup, and generating massive savings in cartridge capacity. Therefore each recovery point is built on the one before it – specific point-in-time recovery is performed by rebuilding the system on the foundation of the initial recovery point and layering the later ones over it, "standing on the shoulders of giants" as it were.

Between recovery point creation, whenever you subsequently create, edit and save files they are protected automatically; existing data is never overwritten and only the newest data is backed up:



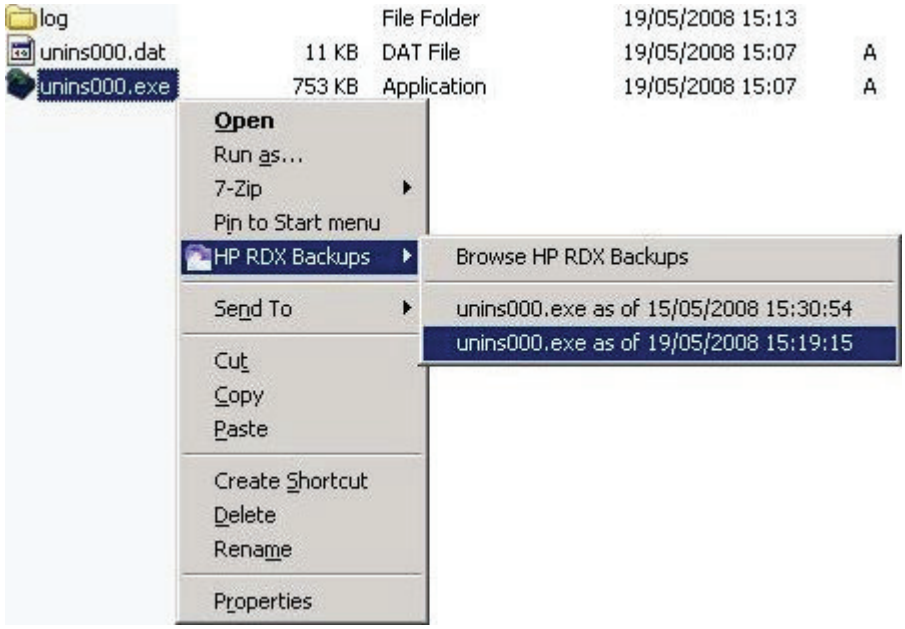
The backup software notes writes to the file-system and collates them to be copied to RDX after a short delay of a few minutes. This is done to reduce disk "thrashing" and improve performance. The overall procedure is summarized below:

Figure 3: RDX Continuous Data Protection process.


A system image (first Recovery Point) is created.
C:\
New files saved to disk are copied to RDX after a short delay.
C:\
Multiple new files are collected and copied to RDX after a short delay.
C:\
New Recovery Points are created periodicall
to include changes to the initial system image
C:\

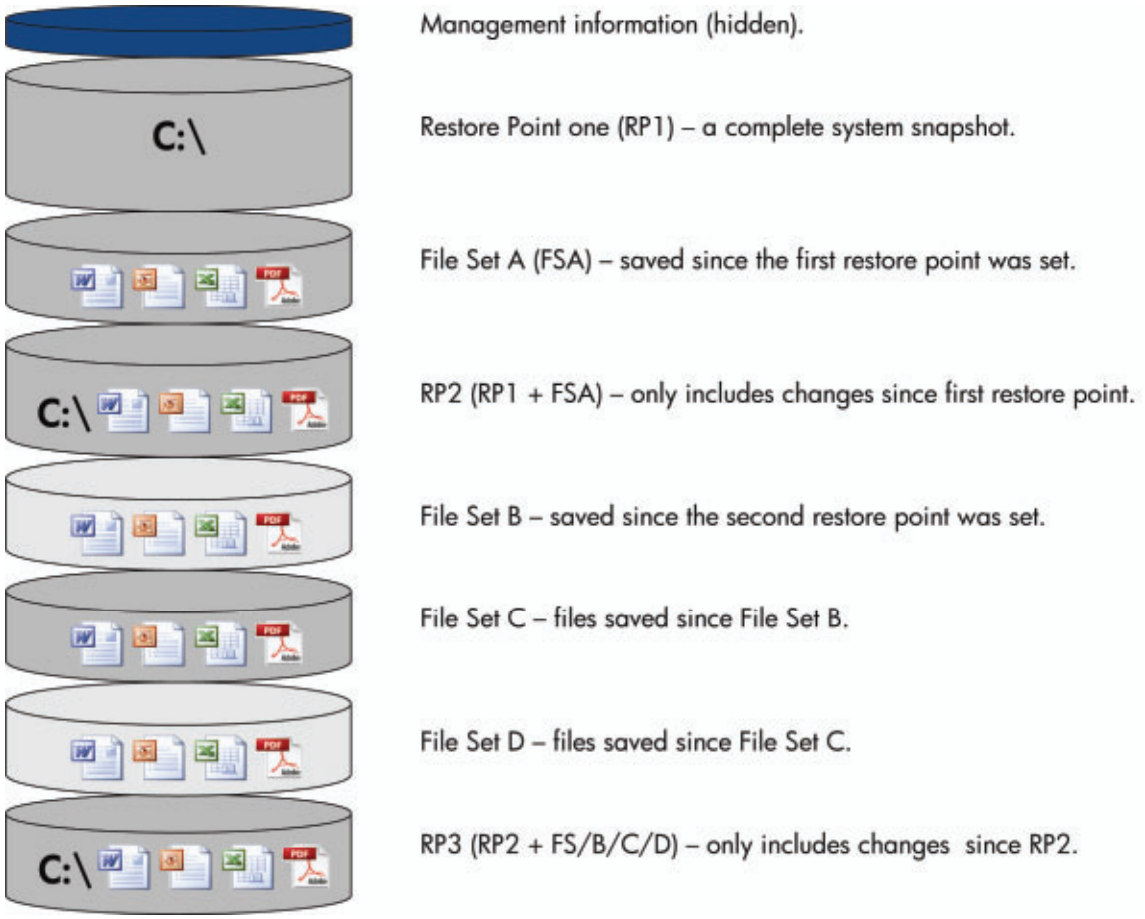
It is this continuous data protection as files are created, edited and saved that allows for file versioning to take place. This feature allows files to be restored to a previous version through a simple right-click:

Figure 4: Right-click restoration of previous versions.



From the creation of the initial recovery point onwards, layers of file versions and successive recovery points are written to the RDX cartridge:

Figure 5: Layers of data stored on RDX cartridge.

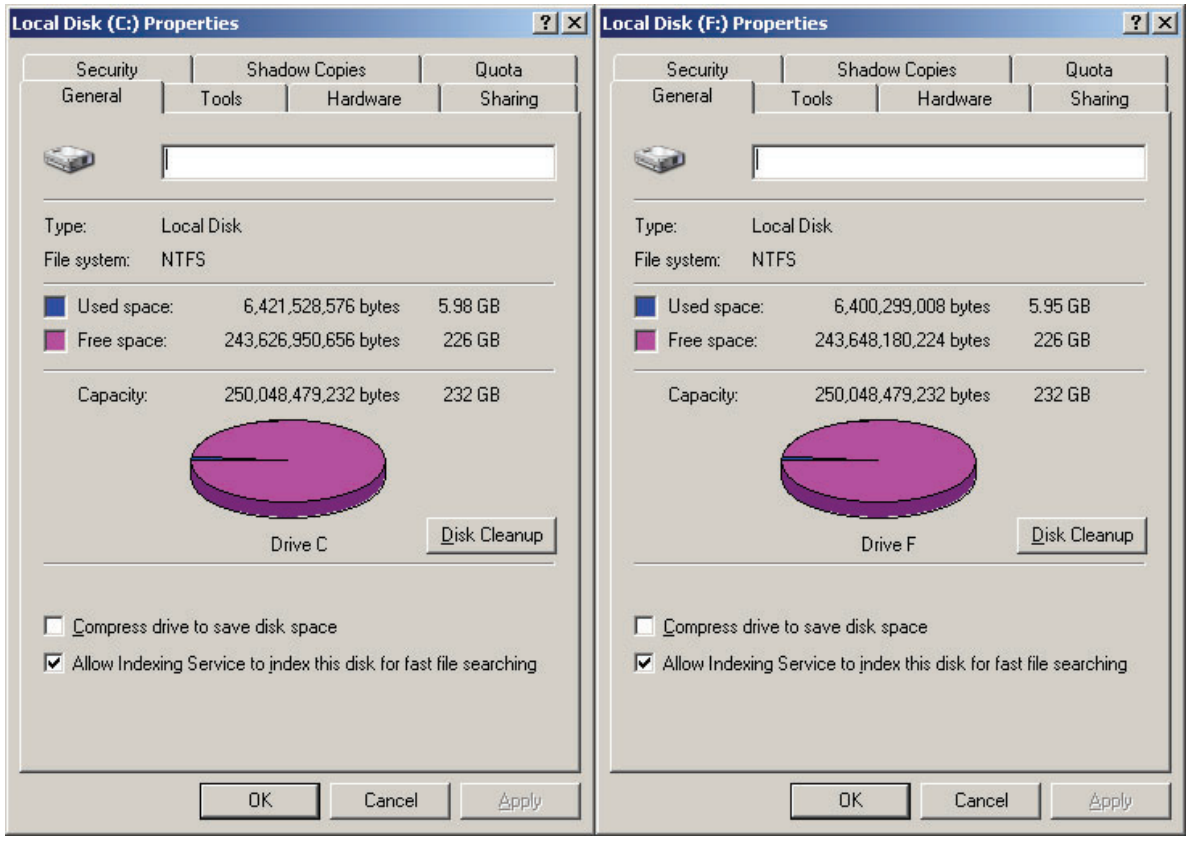

Management information (hidden).
C:\
Restore Point one (RP1) – a complete system snapshot.
File Set A (FSA) – saved since the first restore point was set.
C:\
RP2 (RP1 + FSA) – only includes changes since first restore point.
File Set B – saved since the second restore point was set.
File Set C – files saved since File Set B.
File Set D – files saved since File Set C.
C:\
RP3 (RP2 + FS/B/C/D) – only includes changes since RP2.

While these techniques protect the maximum amount of data in the most space-efficient way, further reductions in used RDX capacity can be achieved through the use of data deduplication techniques [1]. As data is copied to RDX from the host, the file-system information is divided into "chunks" which are "hashed" using an industry-standard algorithm, creating a unique electronic signature. These hashes are stored by the backup application for future comparison with hashes generated by incoming data. If two chunks are found to have the same hash they must contain the same data – as there is no point in storing the same data twice, a "pointer" to the new chunk of data replaces the original, which is removed to save space. Pointers always direct to the newest copy of the data to ensure integrity. Deduplication takes place in the downtime, after each backup has completed, to reclaim space on the RDX media. Once deduplication has been performed the backed-up data is also compressed to save even more space.

[1] Single-file instancing available at launch, sub-file deduplication available by September 2008.

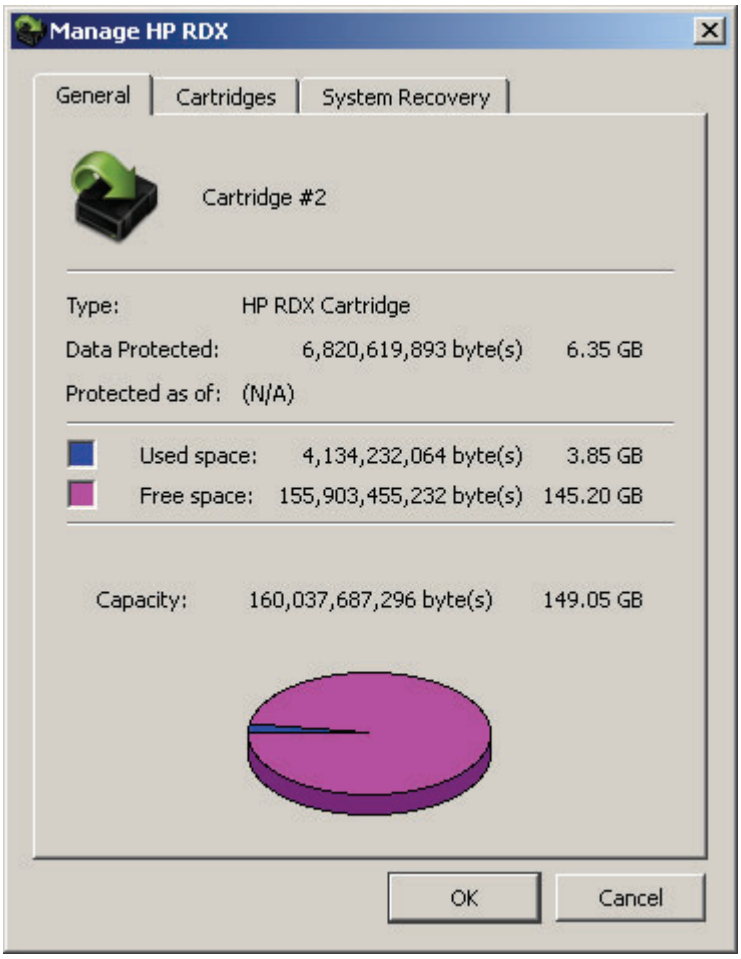
An excellent illustration of the kind of space saving possible was generated by splitting a RAID 1 mirror of our test server's system disk. After separation the first disk became "C:\" and the second "F:\", each containing almost identical data:

Figure 6: C:\ and F:\ drives, ~5.9GB each.



This system was then protected with the HP StorageWorks RDX Removable Disk Backup System to a 160GB RDX cartridge. Were the contents of both hard disks merely copied to the RDX media, it would have consumed 11.93GB. With deduplication of identical content and compression of the remainder, the results shown in Figure 7 were achieved:

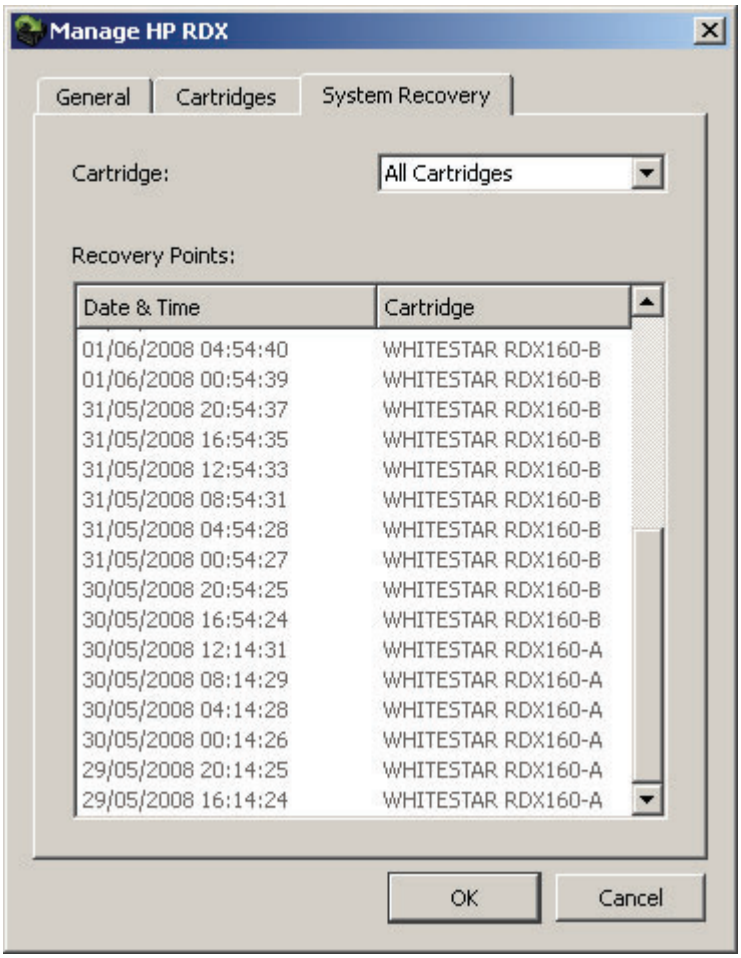
Figure 7: Result of deduplication and compression.



Only 3.85GB of space is actually used on the RDX media, a reduction of 8.08GB from the original total of 11.93GB. It should be noted that this is an extreme example as the two hard disks contained almost completely identical data, a situation unlikely in real-world use.

With use the RDX cartridges will eventually contain many recovery points so the software keeps track of the recovery points on each cartridge as shown in Figure 8:

Figure 8: Index of stored Recovery Points.



This allows the user to locate the appropriate cartridge containing the range of recovery point they require to restore the entire system to a prior state.

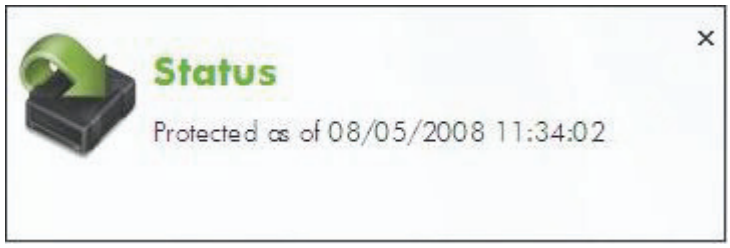
Typical Usage Models

Two-cartridge rotation with HP StorageWorks RDX Continuous Data Protection Software

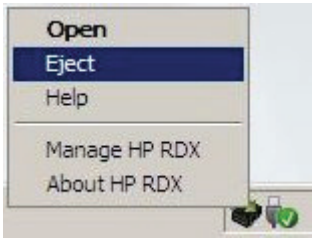
The simplest and most reliable way to protect your data is with the included HP StorageWorks RDX Continuous Data Protection Software using two RDX cartridges alternating each day of the week. This scenario allows for one cartridge to protect the system while the previous day's is kept offsite in case of disaster. Each cartridge is used only three times per week and each contains a complete set of backups capable of totally restoring the system to any recovery point set up to the time it was last used. Coupled with deduplication and compression this scheme also allows for greater use of cartridge capacity by halving the amount of data written to a single cartridge over a given time.

To implement this model, use the following procedure; in this example our two cartridges are called "red" and "blue".

Follow the procedure described in the "HP RDX Continuous Data Protection Software quick start instructions" to create the first day's backup on blue cartridge. Throughout the day your system will be protected:

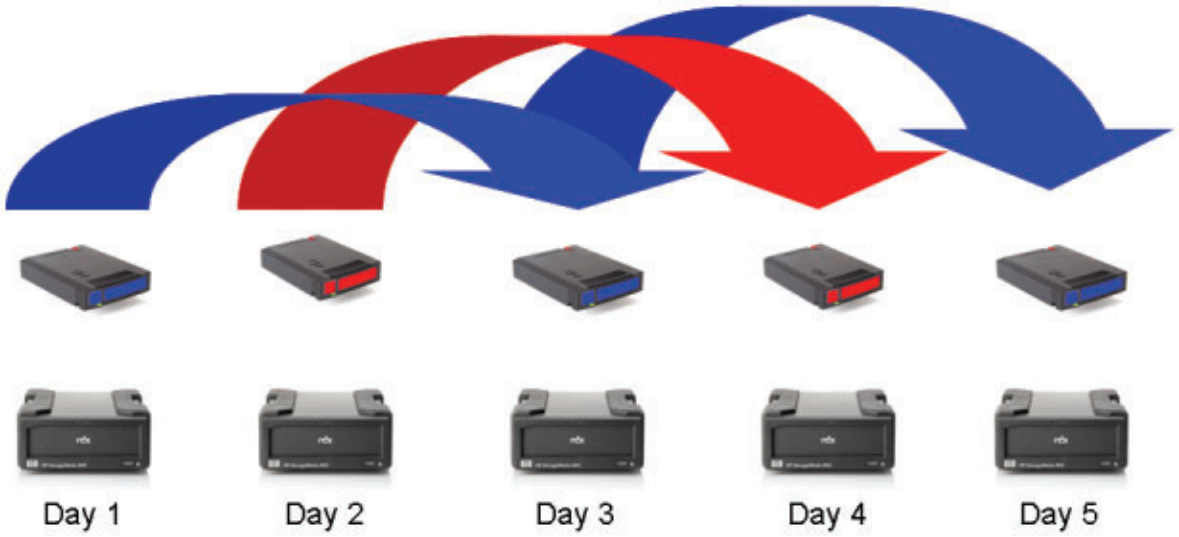


At the end of the day right-click on the tray icon and choose "Eject":



After a short delay, while any outstanding writes to the RDX media are completed, the cartridge will be ejected from the dock. Replace it with red cartridge. Put blue cartridge into its plastic case to keep away from dust and debris and either take it home with you or place it in a safe capable of protecting against fire and water damage. Repeat this process each day of the week as shown in Figure 9:

Figure 9: RDX cartridge "leapfrog" rotation scheme.



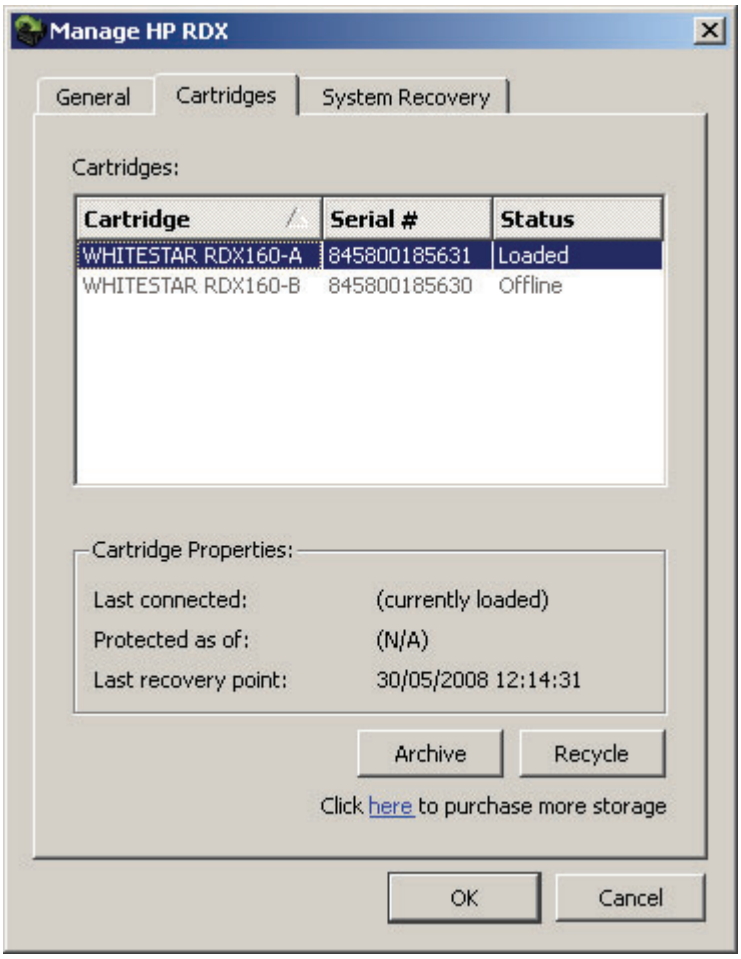
Assuming Day 1 is Monday then each working day of the week is backed up and red cartridge could be used over the weekend to cover Days 6 and 7 as well. This daily rotation of cartridges provides the greatest level of protection – if the cartridges were rotated weekly and disaster strikes the active cartridge, there is a possibility to lose the last week's worth of data.

Important to note that each cartridge has an initial recovery point created at first use (on Day 1 for blue cartridge and Day2 for red cartridge), subsequent recovery points and backups to a cartridge are created with respect to the initial recovery point on that cartridge. **This means that each cartridge is a self-contained backup set that can be used to perform a total system recovery.** This is unlike other solutions that require once-a-week full and daily incremental backups on multiple media – if the media containing the previous week's full backup is damaged then all the daily increments are of little use. This can not happen with the HP StorageWorks RDX Removable Disk Backup System which is a powerful tool in protecting your data.

This simple usage model may be extended to include end-of-year archiving to a dedicated cartridge. In addition, you may have a floating cartridge for transferring large amounts of data to clients; such is the flexibility of RDX technology.

As cartridges fill over time they may be either archived or recycled through the RDX Continuous Data Protection Software management interface:

Figure 10: RDX cartridge management.



"Archive" sets the cartridge read-only so that the HP StorageWorks RDX Continuous Data Protection Software will no longer write new data to that media. "Recycle" formats the media for re-use by the HP StorageWorks RDX Continuous Data Protection Software.

To prevent any writing or formatting of the media by the HP StorageWorks RDX Continuous Data Protection Software or any other utilities, there is a physical write-protect tab on the cartridge that may also be set.

Depending on the depth of data protection you require, you may wish to archive a cartridge when it reaches capacity, replacing it with a new one. This will allow you to maintain a complete backup history. Ideally you should only recycle a cartridge when a new one has replaced it in the backup cycle and the new cartridge has completed its first recovery point.

Pre-existing backup application

You may wish to use a traditional backup application such as HP Data Protector Express to maintain your system. Many backup applications are compatible with RHDD devices allowing integration into your existing routine without changes that might complicate your existing backup processes. Such applications allow you to select or exclude source drives or files and then automatically back up files from source to removable media, usually allowing you to compress or encrypt the data in the process. On completion of the copy job many backup applications can also verify the data to ensure the backup was successful.

Traditional backup applications are capable of complex media rotation schemes which may require a different piece of media for each day of the week. These applications usually maintain an internal catalogue of what backups are on which piece of media and will ask for the correct media when required.

In this instance HP would recommend HP Data Protector Express software which is tested with and supports the HP StorageWorks RDX Backup System.

Simple drag-and-drop to a single RDX cartridge

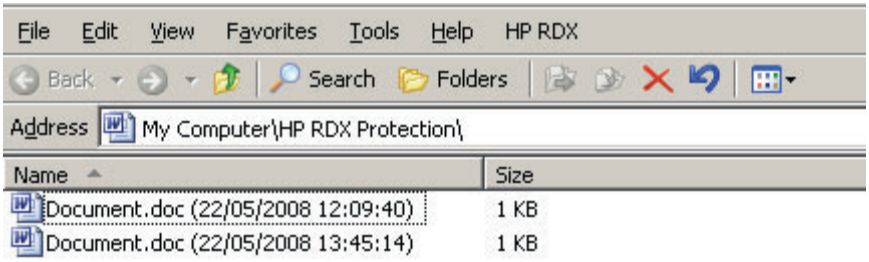
The simplest and most straightforward way to use the HP StorageWorks RDX Backup System is through Windows Explorer using a drag-and-drop operation to the drive letter assigned to the USB drive. This usage model is a practical method of archiving files and freeing space on your system by moving files from your hard disk to RDX. While easy, this is the least space-efficient method, using a compression utility to zip the data will improve this. If you use multiple cartridges you will manually need to keep track of which files are on each piece of media.

Recovering files

Double-click on the RDX icon in the system tray or select "RDX Protection" in "My Computer" to display a list of the drives that have been backed up. Select a drive and navigate as in a normal Windows Explorer window. The location of files in RDX Protection mirrors the file structure on the hard disk and includes files that may subsequently have been deleted from the hard disk folder.

- To recover the latest version of a file, simply drag and drop it onto the desktop or a folder. The file is automatically restored to its original location on your hard disk.
- To recover an earlier version of a file, double-click first on the file name to display a list of all available versions and select the required one.

Figure 11: Multiple file revisions.



By default, all files and folders that have been protected (online and offline) are shown. If you try to restore a file that is not on the current cartridge, you will be prompted to insert the correct cartridge. To show only online versions, disable **Offline versions** in the HP RDX menu.

Recovering a system (Bare Metal Recovery)

1. Insert the HP RDX Continuous Data Protection CD into the server or workstation.
2. Make sure that the RDX Removable Backup System is connected.
3. Reboot the server or workstation. It will boot from the CD.
4. Select the appropriate language and accept the warning that any data on the hard disk will be lost.
5. A number of screens are displayed that allow you to make specific choices for disk recovery. Choose:
   - the appropriate RDX cartridge and make sure that it is loaded
   - the system, if more than one has been backed up to the cartridge
   - the volume (which disk(s) should be restored)
   - the required recovery point (date and time)
   - the target disk
6. Once you confirm the target disk, restore commences and may take several hours. On completion you will be prompted to reboot the computer and the CD is automatically ejected.

Compatibility

Our extensive compatibility testing program assures that your HP StorageWorks RDX Removable Disk Backup System works with leading servers, operating systems, and backup applications.

HP Server and Workstation Compatibility

The HP StorageWorks RDX Removable Disk Backup System is compatible with HP ProLiant servers and HP workstations. HP StorageWorks RDX Removable Disk Backup System is supported on the following classes of HP systems:

- HP ProLiant DL servers
- HP ProLiant ML servers
- HP Personal Workstations

NOTE:
HP recommends that no more than one HP RDX Removable Disk Backup System be connected to a system at a time.

OS Support

Microsoft® Windows®

- XP
- Server 2003
- Vista
- Server 2008.

GNU/Linux

- Red Hat Enterprise Linux 4
- SUSE Linux Enterprise Server 9
- SUSE Linux Enterprise Server 10

Backup Software Support

- HP Data Protector Express
- CA ARCServe Backup
- Symantec Backup Exec

And other backup applications that support removable disk media.

NOTE:
For the latest list of servers, workstations, operating systems, and backup software, including third-party systems, that support the HP RDX Removable Disk Backup System, please visit: http://www.hp.com/go/connect for the latest compatibility information.

Frequently asked Questions

Q. Isn't RDX just another external USB disk drive?

A. No. External USB disk drives are limited by their fixed capacities whereas RDX has essentially unlimited capacity due to its removable media. While any RDX cartridge will fit in any RDX dock, additional external USB drives from different vendors would require many, often incompatible, power cords and individual USB cables leading to increased clutter.

Q. Is RDX bootable?

A. Yes, on hardware and operating systems supporting boot from USB devices.

Q. How does the HP StorageWorks RDX Continuous Data Protection Software handle open-file-backup of services like Exchange or Oracle?

A. Open-file-backup is done when each Recovery Point is set by utilizing the Volume Shadow Copy Service (VSS) technology in the underlying Microsoft Windows OS. Your application requires a suitable plug-in to the VSS API to allow this to occur.

Q. What is the minimum system state required for bare-metal disaster recovery?

A. A bootable CD-ROM drive, any supported hardware RAID arrays configured, dock connected, cartridge inserted then boot from the recovery CD.

Q. Can I take the device from Server1 to Server2 (assuming identical hardware) to perform a restore (or clone)?

A. Yes. Windows will go through its hardware detection process and re-enumerate all the devices. NOTE: Certain versions of Windows may require re-activation after restoration to different hardware.

Q. Is this device supported on GNU/Linux or other platforms such as Mac OS X?

A. HP offers support for connectivity and hardware on several variants of GNU/Linux. The HP StorageWorks RDX Continuous Data Protection Software requires Windows XP or later. Other systems with certified USB 2.0 interfaces such as Mac OS X may be compatible but are not supported by HP. Please visit http://www.hp.com/go/connect for more information.

Q. Is my HP RDX dock unit compatible with other RDX-logoed media?

A. Yes. Any RDX-logoed media will fit any RDX dock. The dock is backwards and forwards compatible with every generation of RDX media.

Summary and Conclusions

All businesses are seeing an increase in data capacity requirements. For micro and small businesses, the amount of data storage required may exceed the limits of current CD/DVD-R devices. In addition to providing greater storage capacity, the RDX Removable Disk Backup System scales easily as capacity needs grow.

The HP StorageWorks RDX Removable Disk Backup System provides "set and forget" data protection for micro and small businesses in which backing up data is just one of several duties for an administrator or business owner, which have limited IT budgets, and for which backing up critical data is too time-consuming.

Micro and small businesses may rely on external USB drives for backup. As RDX cartridges are readily moved offsite, the HP StorageWorks RDX Removable Disk Backup System offers greater data protection than an external USB drive. In addition, the durable data cartridges are designed for long life expectancy.

The HP StorageWorks RDX Removable Disk Backup System offers the performance of disk backup in an easy-to-use system with all the benefits of removable storage for offsite disaster recovery and archiving.

Appendices

Models

HP StorageWorks RDX160 Internal Removable Disk Backup System	AJ765A [2]
HP StorageWorks RDX160 External Removable Disk Backup System	AJ766A
HP StorageWorks RDX320 Internal Removable Disk Backup System	AJ767A [2]
HP StorageWorks RDX320 External Removable Disk Backup System	AJ768A

Media

HP 160GB RDX Removable Disk Cartridge	Q2040A
HP 320GB RDX Removable Disk Cartridge	Q2041A

[2] 0D1 will appear after the part number if factory integration is indicated.

Specifications

Capacity	Native/Compressed (assumes 2:1 application-based data compression)	160GB/320GB or 320GB/640GB
Performance	Average sustained transfer rate, native	30MB/s
	Average sustained transfer rate, compressed (assumes 2:1 application-based data compression)	60MB/s
	Burst transfer rate (USB 2.0)	480MB/s
	Data access time	15 milliseconds
	Supported file systems	FAT32, NTFS, ext2, ext3
Reliability	MTBF (Dock)	550,000 hours @100% duty cycle
	MTBF (cartridge)	500,000 hours
	Uncorrected Error Rate	1 error per 10^{14} bits read
Durability	Docking Station Load/Unload cycles	10,000 (minimum)
	Cartridge Load/Unload cycles	5,000 (minimum)
Interface	Interface type/connector	USB 2.0/USB standard series B receptacle
Compatibility	Backwards and forwards compatibility to any current/future RDX removable disk cartridges	
Power Specifications	Power requirements, Internal	+5V ± 5% (100mV Max ripple) @1.3A
		+12V ± 10% (150mV Max ripple) @0.005A
	Power requirements, External	100 to 240 VAC, 50-60 Hz, auto-ranging
	Power consumption	6.6 W/20W (typical/peak)
Environmental Specifications	Temperature range	10 to 40 degrees C (operating), -40 to 65 degrees C (non operating)
	Relative humidity	20 to 80%, non-condensing (operating), 10 to 90%, non-condensing (non-operating)
	Altitude	-50 ft to 10,000 ft (operational), -50 ft to 35,000 ft (non operational)
	Vibration	random vibe(operational): 0.30Grms 5Hz to 500Hz sine vibe(non-op): 0.75g (0-peak) 5Hz to 500Hz random(non-op): 2.41Grms 5Hz to 500Hz
		half sine 31G @2.6ms (operational), half sine 71G @ 2ms (non operational)
	Shock: Cartridge non-operating drop shock	1m (39.37") drop to tile over concrete floor

For more information

http://www.hp.com/go/rdxbackup
http://www.hp.com/go/connect
http://www.hp.com/go/storagemedia

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